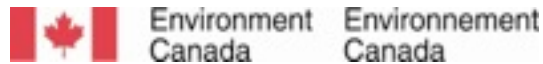




Zero Energy Housing

September 2011

Presented by:



In collaboration with:



Global Drivers & ZEH Contribution Potential

Project Lead:



THE SHIFTING ENERGY & SECURITY GLOBAL LANDSCAPE

Energy is the foundation of industrialized society.

Our institutions, businesses, and the provision of basic human needs depends on a reliable supply of affordable energy...

...that does not unduly affect our economic, environmental and social security.

- There is a growing imbalance between energy supply and demand. Energy demand growth is exceeding production growth, leading to increased supply scarcity.
- Global primary energy consumption will grow nearly 50% from 2005 to 2030 (IEA / World Energy Outlook)
- A significant portion of primary energy generated is wasted as a result of transmission loss and storage.
- Security issues include geopolitical stability, economic security, environmental stress and infrastructure resiliency.
- Energy generation, transportation and consumption contributes to GHG emissions and associated air pollution.

BUILDING SECTOR LINKAGE TO GLOBAL ENERGY & SECURITY ISSUES

Energy is the foundation of industrialized society.

Buildings account for close to 40% of energy used in most countries.

SOURCE: International Energy Agency: <http://www.iea.org/subjectqueries/buildings.asp>

- There is a growing imbalance between energy supply and demand.
- Simply increasing energy supply will not solve the current energy situation and associated environmental problems. ZEH enables the home to be part of the energy mix solution.
- Global primary energy consumption will grow nearly 50% from 2005 to 2030 (IEA / World Energy Outlook)
- The building sector significantly impacts growth as the sector accounts for 40% of energy use.
- A significant portion of primary energy generated is wasted as a result of transmission loss and storage.
- ZEH diversifies energy supply and provides demand reduction measures that reduce peak load, provide load levelling and contribute to reduced infrastructure growth demand.
- Security issues including geopolitical stability, economic security, environmental stress and infrastructure resiliency.
- ZEH provides opportunities to address each security issue.
- Energy generation, transportation and consumption contributes to GHG emissions and associated air pollution.
- ZEH can be part of a mitigation strategy. Energy efficiency is the lowest and often net negative abatement cost. (McKinsey & Co., 2008)

SECURITY ISSUES

Geopolitical STABILITY

Economic SECURITY

Environmental STRESS

Infrastructure RESILIENCY

THREATS

Threats from unequal energy source distribution...

- Source ownership
- Foreign control of supply
- Trade leverage inequality

Distruptions from energy market uncertainty...

- Price instability
- Operational & supply chain risk
- Civil unrest
- Gov't bailouts

Impacts from extraction, production and combustion of energy....

- Habitat destruction
- Compromised ecosystem services
- Public Health

Risks from natural, operational and security shocks...

- Infrastructure efficacy & efficiency
- Infrastructure renewal & expansion cost

OPPORUTNITIES

- Strengthen energy independence
- Decouple energy & diplomacy
- Decrease supply chain risk

- Decrease operational risk to business & consumers
- Reduce public costs of energy subsidization

- Reduce emissions in grid energy generation
- Minimize ecological footprint of buildings

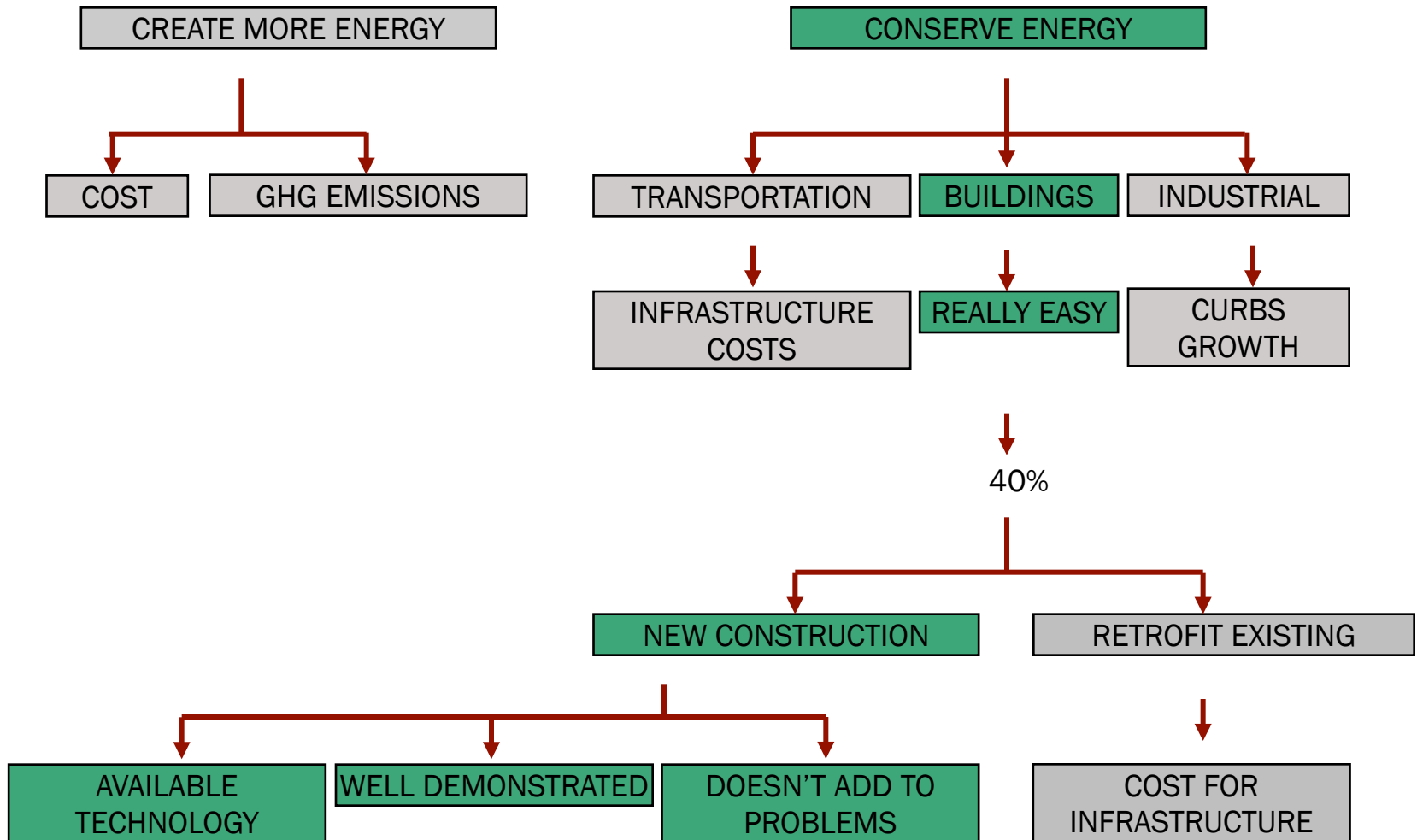
- Smarter, more efficient energy systems
- Reliability from distribution
- Power to off-grid areas

ZEB CONTRIBUTIONS

INCREASING ENERGY DEMAND OPTIONS

IEA WORLD ENERGY OUTLOOK

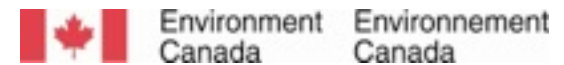
50% INCREASE IN PRIMARY ENERGY CONSUMPTION FROM 2005 - 2030



Environment Canada's ZEH Activities

Asia Pacific Partnership
Canada-Mexico Partnership
Renewable Energy & Energy Efficiency Partnership

Project Lead:



PROJECT OBJECTIVES & ACTIVITIES

OBJECTIVES:

- Accelerate the identification of optimal solutions
- Enhance networking, technology transfer and awareness
- Improve conditions for innovation
- Transform the market.

ACTIVITIES:

- Public – Private collaboration approach
- Facilitating dialogue among partner countries
- Design charrettes to explore national/regional issues
- Demonstrations to fine tune national/regional solutions
- Expanded APP collaboration to include Mexico
- Preliminary dialogue with Brazil
- Events in Mexico at COP16
- Stakeholder roadmap
- Energy Security Primer
- Value Chain analysis
- Google Map of case studies
- ZEH carbon methodology



Inspiration – MINTO, Ottawa



Los Héroes – GRUPO SADASI , Cancún

ZEH Roadmap & Stakeholder Interaction

Project Lead:



WHAT DOES ZEH LOOK LIKE?

- Elements of ZEH:
 - Thermal insulation
 - Solar shading
 - Ventilation
 - High performance windows
 - Air tight structures
 - Natural daylighting
 - Energy efficient appliances
 - Renewable energy system
 - Energy efficient lighting
 - Heat / cold recovery
- There is no single solution to achieve ZEH. Considerations include:
 - Climate-responsive
 - Flexible design
 - Location-specific
 - Holistic design consideration
 - Consider total energy use rather than isolated systems

Order of priority

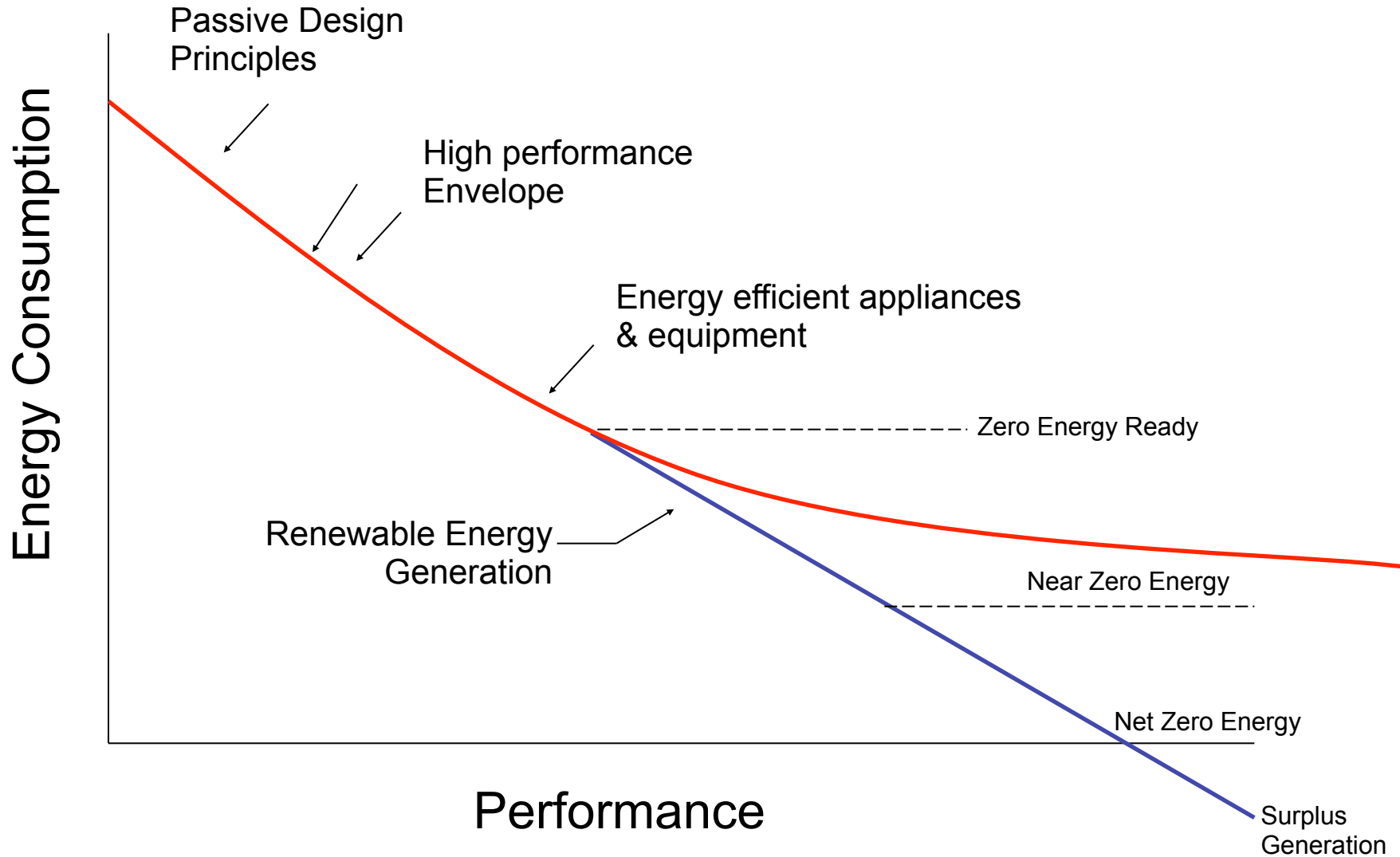
- Energy conservation
- Passive and energy efficiency



Santa Barbara Garden – Shanghai Daan Real Estate Co. Ltd. & Insightful Healthy Homes, Shanghai, China

COST EFFECTIVE PATH TO ACHIEVE ZEH

Energy efficiency is the cornerstone of ZEH to ensure reduced renewable energy requirements.



Passive design recognizes local conditions and the physical properties of air, water and the sun to maximize the natural heating, cooling and lighting potential of a home.

NATURAL VENTILATION

- Stack and cross ventilation – natural airflows through the living space – provide fresh air and promote cooling without mechanical assistance.



Natural ventilation: GEO, Mexico

WATER SAVING

- Permeable paving and rain barrels reduce use of municipal water for irrigation – water treatment is one of the single largest energy costs for municipalities.



Solar Control: GEO, Mexico

SOLAR CONTROL

- Awnings and vegetation provide external shading to prevent heat gain from direct sunlight.
- Building orientation – positioning building features like windows and walls relative to the sun – promotes solar heat gain in cold climates or prevent it in warm ones.

REFLECTANCE

- Light-coloured roofs and building exteriors reflect significant amounts of sunlight – reducing solar heat gain.



Reflectance: AusZEH – Henley, Australia

Space heating/cooling is typically a home's largest energy requirement. A high-performance building envelope will greatly reduce unwanted heat-loss and heat-gain in the home.

AIR SEALING

- Thorough sealing around windows and doors as well as stacks, vents and other wall penetrations, maintains a tight building envelope and prevents drafts.

THERMAL BREAKS

- Eliminate thermal bridging of building components such as wall studs and beams to avert heat loss from conduction.

INSULATED FRAMES

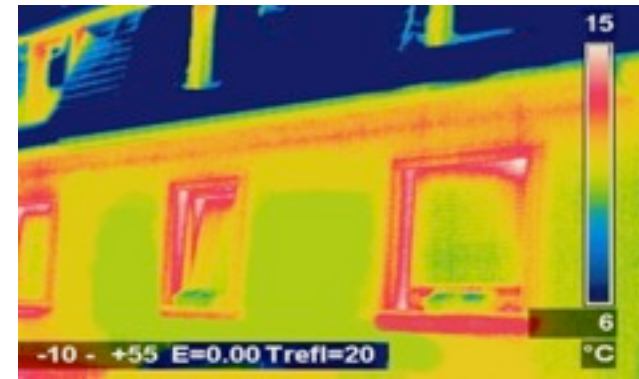
- Insulating spacers and frames prevent thermal bridging and minimize gaps that form from expansion and contraction.

ENERGY EFFICIENT WINDOWS

- Certified, double/triple pane, low-e, energy efficient windows and doors reduce heat transfer significantly.

INSULATION

- A high level of insulation in external walls and the roof minimizes heat transfer and the need for supplementary heating and cooling.



An airtight house requires mechanical ventilation and efficient, appropriately sized appliances to maximize performance.

ENERGY EFFICIENT APPLIANCES

- New, certified appliances not only consume less energy, but also have features such as variable load settings and timers to run when energy is less costly for consumers off-peak.



ENERGY EFFICIENT LIGHTING

- New lighting technologies like CFLs & LEDs use up to 90% less energy than traditional incandescent light bulbs.



ENERGY EFFICIENT WATER HEATING

- In addition to using efficient boilers, a low-cost drain water heat recovery pipe can significantly reduce heating requirements.

ENERGY EFFICIENT HVAC

- Certified and appropriately sized mechanical ventilation and the use of a heat recovery ventilator can significantly reduce the energy required to move and condition air.

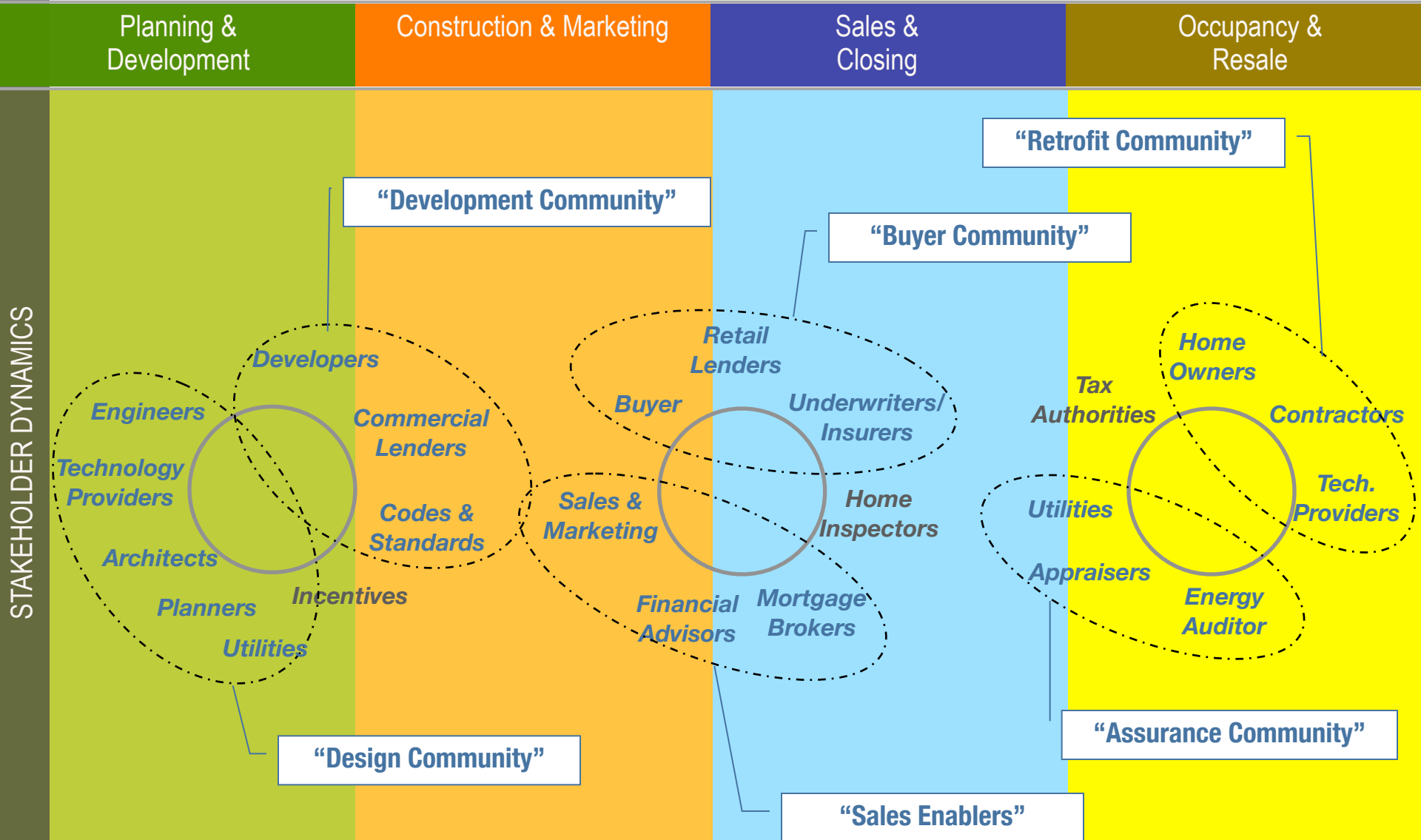


MANAGING CONSUMPTION

- Building controls and intelligent user interfaces help homeowners understand and control their energy consumption.

ENGAGING STAKEHOLDERS

ZEH market adoption requires engagement with a broad network of stakeholders.



National Value Chains

Project Lead:



Value Chain Objective:

To examine the value chain of home building in countries as it relates to ZEH adoption, with a view to strengthening regional understanding of how market conditions may be influenced to achieve positive ZEH outcomes.

National Value Chains:

Argentina
 Australia
 Brazil
 Canada
 China
 Colombia
 Costa Rica
 India
 Japan
 Korea
 Mexico
 United States

Support Factors

Development Activities

A. MARKET FUNDAMENTALS							
B. MARKET DRIVERS							
C. EDUCATION							
D. FINANCIAL ENVIRONMENT							
E. CODES & STANDARDS							
F. DEVELOPMENT DRIVERS							
G. TECHNOLOGICAL CAPACITY							
H. ASSURANCE CONDITIONS							
1. PLANNING	2. DESIGN	3. CONSTRUCTION	4. SALES	5. OPERATION	6. RE-SALES	7. RETRO-FITS	8. DEMOLITION

BUILDING ZEH: VALUE CHAIN OVERVIEW

SUPPORTING FACTOR		Australia	Canada	Brazil	India	Japan	Mexico	Colombia	USA
A. HOUSING PROFILE	Existing Housing Stock	↓	↔	↔	↔	↔	↔	↔	↔
	Residential Energy Use	↔	↔	↔	↔	↔	↔	↔	↔
	Energy Infrastructure & Energy Prices	↔	↑	↔	↔	↔	↔	↔	↔
	Energy Mix	↓	↔	↔	↓	↔	↔	↔	↔
	Housing Growth	↔	↔	↑	↓	↑	↓	↓	↔
	Housing Demand Areas	↔	↔	↔	↔	↔	↓	↓	↑
B. CONSUMER ENVIRONMENT	Consumer Awareness	↑	↑	↓	↔	↔	↔	↑	↓
	Consumer Education	↑	↔	↑	↔	↔	↓	↑	↑
	Cultural Principles	↔	↓	↔	↓	↔	↔	↓	↔
	Housing Affordability	↔	↑	↓	↔	↑	↓	↓	↔
C. FINANCIAL ENVIRONMENT	Lending Instruments	↑	↓	↑	↓	↑	↑	↑	↑
	Investment Opportunities	↔	↑	↑	↑	↔	↔	↑	↑
	Risk Valuation	↑	↔	↔	↔	↑	↔	↓	↑
	Contractual Assurance	↔	↑	↔	↔	↔	↔	↓	↔
D. REGULATORY ENVIRONMENT	Political Capital	↑	↔	↑	↔	↑	↑	↑	↑
	Building Code	↑	↔	↑	↔	↔	↔	↑	↔
	By-Laws	↑	↓			↑			
	Inspection/Appraisal Rigor	↔	↑	↔	↓	↑	↔	↓	↔
	Labelling and Certification	↑	↔	↑	↔	↑	↔	↑	↑
	Carbon Regulation	↑	↔	↑	↔	↑	↔	↑	↔
E. INDUSTRY CAPACITY	Design Approaches	↑	↑	↔	↔	↑	↔	↔	↑
	Available Products	↑	↑	↓	↓	↔	↔	↓	↑
	Skilled Labour	↑	↑	↓	↓	↔	↔	↓	↑
	Industry Training	↑	↑	↑	↓	↑	↔	↑	↑
	Best Practices	↑	↑	↔	↔	↔	↑	↔	↑
	Performance Assurance	↔	↔	↓	↔	↑	↔	↓	↔

- 10 distinct *ISSUE AREAS* for knowledge sharing and collaboration emerged from the value chain analysis.
- *MOBILIZATION TACTICS* are opportunities for action on advancing ZEH. These may involve leading new programs, supporting existing efforts, or creating partnerships with external organizations.

1. FINANCIAL MOBILIZATION
2. LOCALIZED BUILDING APPROACHES
3. BUILDING PERFORMANCE ASSURANCE
4. CONSUMER EDUCATION
5. TRAINING & CAPACITY BUILDING
6. POLICY FRAMEWORKS
7. ADEQUATE HOUSING
8. INFRASTRUCTURE INTEGRATION
9. FACILITATING PROCUREMENT
10. RECOGNIZING SUCCESS

International Zero Energy Housing Map

Project Lead:



Locate buildings on the *Interactive Map*.

Filter by :

- *Building Type*
- *Number of Units*
- *Size of Development*
- *Electricity Generation*

Partners may log-in to *add and edit their own buildings*.

The screenshot shows the website for the Asia-Pacific Partnership on Clean Development and Climate. The main heading is "Zero Energy Housing Map". Below the heading, there is a navigation menu with links for "Home", "What is ZEH", "About the Map", "Country Summary", and "Contact Us". On the left side, there is a login form with fields for "Username" (containing "jeff") and "Password" (masked with asterisks), a "Remember Me" checkbox, and a "Login" button. Below the login form are links for "forgot your password?", "forgot your username?", and "Create an account". To the right of the login form, there are filter options: "Filter results:", "Building Type:" (a dropdown menu set to "Select one"), "Number of units:" (a dropdown menu set to "Select one"), "Size:" (a dropdown menu set to "Select one"), and "Electricity Generation Capacity:" (a dropdown menu set to "Select one"). The main content area features a world map with several red location pins. One pin is in Asia, one in Australia, and one in North America. A blue circular icon with a question mark is overlaid on the map. The map is powered by Google Maps, as indicated by the logo in the bottom left corner.

View *Building Details*, including:

- *Builder info*
- *Building Details*
- *Performance Metrics*
- *Building Approaches*
- *Photos*
- *“ZEH Score”*

(% of energy generated beyond the needs of the building)

$$\frac{(\text{Total energy generated} - \text{Total energy consumed})}{\text{Total energy generated}} \times 100$$

Zero Energy Housing Map
Zero Energy Housing Map > AusZEH

Map showing the location of AusZEH (40 Mabel St, Doreen, Victoria, 3754, AU) on a map. The map includes labels for roads like Masore Rd, Fryer Rd, Arthur's Creek, and Chapel Ln. A red pin marks the building location. The map is powered by Google and includes a copyright notice for MapData Sciences Pty Ltd. (2010).

ZEH Score: 0

General Information

Building Name	AusZEH
Address	40 Mabel St, Doreen, Victoria, 3754, AU
Brief Description	The Australian Zero Emission House (AusZEH) project has the potential to significantly contribute to GHG emissions reduction from residential buildings in Australia.
Builder	Henley Property Group
Link	http://auszeh.org.au/index.html

Building Details

Type of building(s)	Detached Homes Detached Homes
Year Completed	2010
Size	242 m ²
Number of Units	1

ZEH in Mexico



Project Lead:



Environment
Canada

Environnement
Canada

POLITICAL LEADERSHIP AND RECOGNITION

Alliance to Save Energy Honors President Calderón for promoting energy efficiency on low income housing in Mexico. 2009



ENABLING PROGRAMS

Green Mortgage program and the subsidies program “esta es tu casa”



ZEH MEXICO PROGRAM PARTICIPATING ORGANIZATIONS

Sponsor institutions:



Mexican Public agencies:



Mexican Builders:



Technical Expertise:



Sharp Environmental
Work Worth Doing
Hicklin Consulting
Carleton University

Achieve Zero balance between energy use and production of renewable energy during a full year (to accommodate Mexican Power Company restrictions, new two-way smart meters).

Reduce energy consumption to the lowest possible, not to exceed lowest subsidized rates, combining architectural and urban bio-climate design and the use of government approved eco-technologies (solar water heating, CFL's, insulation and AC efficient units, etc.) to achieve maximum energy savings and highest thermal and energy efficiency.

Install PV systems to generate energy during high demand, daylight time.

2009

CONAVI & INFONAVIT receive ASE International Award
ZEH Workshop

2010

GEO & URBI Charrette
VINTE Charrette
SADASI Charrette
INFONAVIT Sustainable Communities Conference
CMP Discussion at Niagara-on-the-Lake
Testing LOTS and LOTS of Testing
Environment Canada receives ASE International Award
ZEH Workshop at COP16
Exhibit at Green Solutions as part of COP16 activities
VIP Tour of URBI, VINTE, SADASI and ARA demonstrations
President Calderon inauguration of VINTE demonstration
Showcased results at ASE event at COP16
Shared results with the IPEEC SBN

2011

ARA Charrette
More testing
INFONAVIT Conference & Training Session
Carbon methodology framework dialogue
INFONAVIT Sustainable Communities Conference

Charrette goals:

A workshop to study the energy demand for a model project including the building envelope.

Identifying all possible energy reductions within a budget criteria for maximum ROI and GHG reductions.

Use of renewable energy sources

- ✓ Structural elements
- ✓ Arquitectural elements for shading and interior lighting.
- ✓ Thermal insulation requirements by climate zone
- ✓ Thermal mass and buildings orientation
- ✓ Home appliances, solar thermal, PV panels, etc.
- ✓ Modeling

ZEH MEXICO DEMONSTRATIONS



ARA: Cancun



VINTE: Playa del Carmen



URBI: Mexicali



GEO: Coatzacoalcos



GEO: Acapulco



URBI: Cancun



SADASI: Cancun

Why is air tightness important?

- Reduces the effectiveness of thermal insulation
- Primary moisture transport mechanism which can lead to structural deterioration and occupant discomfort
- Does not provide controlled ventilation
- Controls drafts, insects, pollen, dust

What does it tell us?

- Shows the size of unintentional openings
- Shows attention to detail – identifies issues with workmanship
- Determines if make-up air is needed
- Investigates potential for spillage
- Investigates potential of soil gas intrusion
- **Allows us to see where our investments are performing as intended**
- **Allows us to find areas for improvement and cost savings**
- **Tests our energy reduction strategy**

How to test air tightness

- Calculate the house surface area and volume
- Seal all intentional openings
- Set installed equipment to exhaust mode
- Open all interior doors
- Close all exterior doors and windows
- Turn off pilot light on heating equipment
- Test according to CGSB 149.10

GOAL 1.5 ACH

ZEH MEXICO TEST RESULTS

AS IS:	14.85 ACH
Window vents	3.78
Back door	1.89
Mini-split hole	0.97
Drains, PV fan	0.67

AS IS:	5.79 ACH
Back door	2.1
Sink, shower drain, & small penetrations	1.98
Windows	0.89

AS IS:	5.44 ACH
Drains	5.0
Door	1.52
Electric outlets + windows	1.33

AS IS:	1.44 ACH
Seal door	1.32

2nd floor, middle unit	
AS IS:	1.08 ACH

AS IS:	5.43 ACH
Door	1.45
Electric outlets + windows	1.31
Patio door	1.10

AS IS:	4.32 ACH
Mini-split holes	3.38
Mini-split + back door	3.05

Ground floor, end unit	
AS IS:	3.64 ACH
Front door	1.06

*** monitored results show 90% reduction in utility bill*

2nd floor end unit	
AS IS:	8.79 ACH
Patio door	7.48
Front door	4.10

AS IS:	4.63 ACH
Door	2.79
Mini-split + door	2.47

WHAT DID WE LEARN FROM THE TEST RESULTS?

What are the common issues?

- Windows and doors leak!
- Wall penetrations **MUST** be sealed!
- Patio doors are really bad
- Natural ventilation strategy needs to be revisited
- Windows are not manufactured properly – gaps, inconsistent
- Workmanship – small errors make a big impact on test results
- Low cost solutions exist

Mexico Simulation

- Improving air tightness from 5 to 1.5 ACH → 4.6% energy reduction
- Double the wall insulation → 3.6% energy reduction
- Double the ceiling insulation → 4.8% energy reduction
- Insulation under the slab → 1% energy reduction
- Move from single to double glazed windows → 6.8% energy reduction
- IF you remove wall insulation → 12% INCREASE

Energy efficiency is the cornerstone of ZEH to ensure reduced renewable energy requirements.

Homes in Mexico can be built to achieve near ZEH goals and be sold at current market prices, even on low income homes (\$20,000.00 to \$35,000.00 US)

Next Steps

WORK CURRENTLY UNDERWAY – CARBON METHODOLOGY

The project is a collaboration led by the Governments of Canada and Mexico as part of the Canada-Mexico Partnership with support from key international experts.

Project Leads:

Objective:

- Develop a draft carbon methodology for Zero Energy Homes
- Identify challenges for GHG accounting and data requirements
- Identify potential metrics for assessing the GHG performance of ZEHs.



Having accurate and verified carbon data for ZEH using a widely accepted, consensus-based standard can play an important role in advancing the international uptake of zero energy homes.



Some key users and potential applications for such a standard can include the following:

- Governments may want to evaluate investment in ZEH as a means to achieve climate change targets
(Objectively Quantify ZEB Performance)
- Developers may want to apply a development project for carbon credits under the Clean Development Mechanism *(CDM Opportunities)*
- Builders may specify materials based on emissions *(Cost/Benefit Decision Making)*
- Building Auditors may want a recognized carbon calculation methodology as an added service offering
(Credible, Widely Recognized System)
- Investors/Financiers may want to create or modify financial instruments to better reflect risk/value from ZEH homes *(Design Financial Instruments for ZEB)*
- Consumers may wish to buy houses verified as being low carbon *(Informative, Understandable Decision Tool)*

CARBON METHODOLOGY DECISION POINTS

Scope of Emission Sources

Definition of ZEH

Normalization method

OPPORTUNITY AREAS FOR MOBILIZATION

- Increase capital
- Reduce the financial carrying costs
- Address the “*split incentive*” for rental/leased properties
- Support innovation for localized ZEH approaches and technologies
- Focus on cost reduction to increase affordability
- Regional best-practices and guidelines based on measured performance
- Integrate energy performance auditing and monitoring within residential construction
- Enforce compliance to building energy codes.
- Improve data transparency around energy usage and costs to influence policy and consumer decision-making
- Support market readiness efforts to provide consumers with understanding of ZEH value proposition
- Increase consumer familiarity to increase buyer demand and confidence
- Provide support to trades
- Disseminate best practices and support knowledge transfer
- Promote aggressive building energy codes and regional energy targets
- Clarify the value of ZEH for local, regional and national governments
- Support policies and regulatory initiatives that support or level the playing field for ZEH
- Create economic opportunities for low-income communities
- Encourage infrastructure development to provide grid connection
- Support grid connection technologies for renewable tie-in and metering
- Support local distributed energy networks and district energy systems
- Facilitate trade of ZEH technologies to improve market accessibility
- Promote development of local manufacturing capacity
- Support retail strategies to increase availability
- Celebrate the achievement of ZEH stakeholders and identify ZEH leaders
- Continue to foster issue-specific working groups/collaborative networks

POTENTIAL OPTION TO ADDRESS AREAS OF MOBILIZATION

Nationally Appropriated Mitigation Actions (NAMA)

- Voluntary GHG mitigation action, policy or program
- Includes enabling conditions (actions without emission reductions)
- UNFCCC process will determine requirement for measurement, reporting and verification
- A registry system will be developed to match support needed and available

WHAT DOES A NAMA LOOK LIKE:

A rebate program for consumers buying energy efficient appliances

or

A subsidy program for energy efficient retrofits

A long term sectoral strategy that identifies the emission reduction potential of ZEH and identifies all of the mitigation actions, policies and programs required to implement the strategy.

- *long term strategy for the whole sector*
- *avoids duplication and silos*
- *ensures all the parts contribute to the longer term goal*
- *articulates sectoral emission reduction potential*
- *registry may find support for individual actions, policies and/or programs*
- *implementation can be done in steps*
- *a plan that enables the sector to contribute to energy & security issues without unduly affecting our economic, environmental and social stability*